

*Abstract of the Invention*

1 An optical device includes a stack of at least two different intersubband (ISB) optical  
2 sub-devices in which the gain/loss profiles of the individual ISB sub-devices are mutually  
3 adapted, or engineered, so as to generate a predetermined overall function for the combination.  
4 We define this combination device as being *heterogeneous* since not all of the individual ISB  
5 sub-devices are identical to one another. Illustratively, the parameters of each individual ISB  
6 sub-device that might be subject to this engineering process include: the peak energy of the ISB  
7 optical transitions (emission or absorption) associated with each RT region, the position of each  
8 sub-device in the stack; the oscillator strengths of these ISB transitions; the energy bandwidth of  
9 each transition; and the total length of the RT and I/R regions of each ISB sub-device. In one  
10 embodiment, our approach may be used to engineer a gain profile that has peaks at a multiplicity  
11 of different wavelengths, thus realizing a multi-wavelength ISB optical source in which the  
12 applied electric field self-proportions itself so that each individual ISB sub-device experiences  
13 the appropriate field strength for its particular design. Alternatively, the gain profile may be  
14 engineered to be relatively flat over a predetermined wavelength range. In another embodiment,  
15 our approach may be used to generate a function that compensates for a characteristic of another  
16 device. For example, our heterogeneous ISB device may be engineered to have a gain profile  
17 that compensates for the loss profile of another device. Alternatively, the gain/loss profile may  
18 be engineered to produce a nonlinear refractive index profile in our device that compensates for  
19 that of another device (e.g., an optical fiber).